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ABSTRACT

This study investigated the perceptions of 30 predominantly white pre-service teachers about African American students' ability to achieve in mathematics and science. Participants completed a three-part, open-ended questionnaire that asked them about their experiences with and awareness of African American students' mathematics and science achievement, reasons for African American students' low mathematics and science achievement, and changes or interventions they would suggest to address this problem. The questionnaire essentially assessed student teachers for awareness of, culpability in, and modifications to improve the mathematics and science achievement of African American students. Results indicated that respondents' perceptions of the mathematics and science ability of African American students were best characterized by King's (1991) notion of "dysconscious racism," an uncritical habit of mind that justifies inequity and exploitation by accepting the existing order of things as given. Over one-third of the respondents were unaware of the problem. Respondents most often placed culpability for achievement with students' culture and community. Respondents overwhelmingly suggested modifications to the teaching and learning process as a vehicle for improving African American students' mathematics and science achievement. (Contains 34 references.) (SM)

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AN INVESTIGATION OF PRESERVICE TEACHERS' PERCEPTIONS OF AFRICAN AMERICAN STUDENTS' ABILITY TO ACHIEVE IN MATHEMATICS AND SCIENCE

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An Investigation of Preservice Teachers' Perceptions of African American Students' Ability to Achieve in Mathematics and Science

INTRODUCTION

> Somehow, I happened to be alone in the classroom with Mr. Ostrowski, my English teacher. He was a tall, rather reddish white man and he had a thick mustache. I had gotten some of my best marks under him, and he had always made me feel that he liked me. He was, as I have mentioned, a natural-born "advisor," about what you ought to read, to do, or think–about any and everything. We used to make unkind jokes about him: why was he teaching in Mason instead of somewhere else, getting for himself some of the "success in life" that he kept telling us how to get?
>
> I know that he probably meant well in what he happened to advise me that day. I doubt that he meant any harm. It was just his nature as an American white man. I was one of his top students, one of the school's top students – but all he could see for me was the kind of future "in your place" that almost all white people see for black people.
>
> He told me, "Malcolm, you ought to be thinking about a career. Have you been giving it thought?"
>
> The truth is, I hadn't. I never have figured out why I told him, "Well, yes, sir, I've been thinking I'd like to be a lawyer." Lansing certainly had no Negro lawyers – or doctors either – in those days, to hold up an image I might have aspired to. All I really knew for certain was that a lawyer didn't wash dishes, as I was doing.
>
> Mr. Ostrowski looked surprised, I remember, and leaned back in his chair and clasped his hands behind his head. He kind of half-smiled and said, "Malcolm, one of life's first needs is for us to be realistic. Don't misunderstand me, now. We all here like you, you know that. But you've got to be realistic about being a nigger. A lawyer – that's no realistic goal for a nigger. You need to think about something you *can* be. You're good with your hands – making things. Everybody admires your carpentry shop work. Why don't you plan on carpentry? People like you as a person – you'd get all kinds of work."
>
> (X, 1964 p.36-37)

The problem that gives impetus to the present study is the low number of African American students who pursue science-related careers (Lewis, 1997; Lewis & Collins, 2000). At least since 1977 African Americans have consistently comprised less than 2% of practicing Ph.D. holding scientists (National Science Board, 1996); and at least since 1971 scholars have sought to understand the causes of underrepresentation through empirical research. While extant research has identified numerous factors, which correlate with students' career decisions, such as the number of math and science courses taken (Thomas, 1984), and the influence of math and science

teachers (Griffin, 1990), this body of research has failed to explain *how* these factors are tied to race. What is it about being African American that leads a student to take fewer math and science courses, or to be differentially influenced by math and science teachers?

The above story of Malcolm Little, an eighth grade student in Mason, Michigan, is instructive in that it underscores one role that *perceptions* and the sociohistorical construction of *race* plays in the *career attainment* of African Americans. Mr. Ostrowski's perception of African Americans' ability shapes the guidance and advice he gives to Malcolm. More importantly, his *stereotyped perception* of African Americans appears to be stronger than his *informed perception* of Malcolm, who was one of the school's top students. It also illustrates how perceptions of African Americans are situated in a sociohistorical context. Mr. Ostrowski's claim that "a lawyer is no realistic goal for a nigger" reflects social as well as historical customs and norms of behavior and expectations. It is much different than an assessment of Malcolm's capabilities.

One's natural tendency might be to recoil at the suggestion that this story, taken from an event in the 1930's, is somehow representative of present day teachers. Moreover, it may be difficult to find a teacher who believes (or who would admit to believing) that African Americans should be consigned to careers in carpentry as opposed to those in law or science. Yet, it is well established that students' race is one factor that shapes teachers' perception of students' ability, independent of students' performance (Braun, 1976). In spite of the facts that (a) participation in science-related careers is clearly demarcated along racial lines, and (b) teacher perceptions are known to influence student achievement, there have been no studies of the impact that teachers' perceptions have on students' career decisions. This exploratory study moves towards filling that void by identifying and describing the perceptions held by pre-service teachers about African American students' ability to achieve in mathematics and science.

LITERATURE REVIEW

Literature on the science career attainment of African Americans is almost singularly focused on describing, explaining, and prescribing solutions for the disparity between African American students and their peers. At least since the 1970's scholars have addressed this racial disparity through reports (National Science Board, 1996), empirical research (Hager & Elton, 1971), and numerous intervention efforts (Carmichael & Sevenair, 1991; Ellis, 1993). Moreover, implicit in these reports, research, and interventions is the identification of antecedent causes for the disparity. Why does the disparity exist? Scholars have approached this question from psychological, cultural, and economic theoretical perspectives, to suggest antecedents to the disparity. One shortcoming of this body of literature, however, is the failure of scholars to appropriate a framework, which stresses the importance of sociohistorical context in science and in the teaching and learning of science.

Psychological Antecedents to Disparity

A segment of scholarship on African American science career attainment can be categorized as psychological in terms of its theoretical perspective. Work in this vein tends to treat disparity as the result of disparate psychological orientations between African Americans and their peers, or between higher-achieving and lower-achieving African American students. An example comes from the work of Post, Stewart and Smith (1991) in which they drew on Bandura's (1982) theory of self-efficacy, to examine the effect of self-efficacy on the math and science career decisions of African American college freshmen. Post, Stewart and Smith found that African American students reported lower self-efficacy, confidence, interest, and consideration of math and science occupations compared to non-math and science occupations. Their study and others like it (Gilleylen, 1993; Griffin, 1990; Krist, 1993) frame the disparity in

psychological terms pointing to psychological antecedents such as self-confidence, interests, and attitudes.

Cultural Antecedents to Disparity

Another segment of scholarship on African American science achievement can be categorized as cultural in terms of its theoretical perspective. This body of work is exemplified in theoretical models popularized in educational anthropology and sociology. One example is the cultural discontinuity model (Ogbu, 1987, 1992), which maintains that low African American academic performance is a result of a discontinuity between students' culture and that of the teacher and/or the school system. Proponents of this model (Clark, 1983; Erickson & Mohatt, 1982; Gilbert & Gay, 1985) point to cultural nuances salient to teaching and learning such as learning styles, relational styles, communication styles and perceptions of involvement. These nuances, they argue are the cultural antecedents of low academic achievement among African American students. Mathematics and science educators have appropriated this model to argue for curriculum changes that are more accommodating of multiple learning styles and students from different cultures (Atwater & Riley, 1993; Melear & Pitchford, 1991).

Economic Antecedents to Disparity

In addition to psychological and cultural framings of the disparity there is scholarship, which associates science achievement disparity with economic differences between African Americans and their peers. This argument is not unique to science education. Several educators (Bond, 1981; Oakes, 1995; Sowell, 1994) have argued that African Americans exhibit low academic achievement because they have fewer of the amenities conducive to school success (e.g. good teachers, role models, good educational facilities, and middle class family backgrounds). Malcom (1990) adopts this perspective to explain the underrepresentation of African Americans

in science. According to Malcom, the lives of African American students could be depicted as being "cumulatively disadvantaged." This means that "Black school children receive less of everything that is needed to succeed" (p. 251). Malcom identifies the disadvantaged condition of African American students as consisting of: inadequate preparation – caused by tracking, fewer prerequisite courses correlated to science-related careers, less exposure to good enthusiastic science teachers, and fewer mentorship opportunities – caused by the already existing underrepresentation.

Sociohistorical Antecedents to Disparity

Taken alone, each of these perspectives offers valuable insight by revealing different sides of a complex social problem. Taken as a whole, however, this body of literature is grossly lacking. It fails to consider the social and historical construction of race, which may be at the root of the social problem. Why stress the sociohistorical significance of race when seeking to understand disparate science career attainment? First, race has been central in the construction of social institutions throughout the history of Western society. This is a point stressed by Jones-Wilson (1990),

> For Blacks in the United States the reality is that race, as it has been biologically and socially defined, has been a major determining factor in institutional arrangements, particularly with respect to the dominant power structure's formulation of what is considered to be appropriate educational policies, programs, and practices. Throughout U.S. history the dominant economic, political, and social ideologies regarding our reason for being in this country and our appropriate place in its structures have interacted to shape our educational arrangements, education being a subordinate social institution (p.119).

Moreover, perceptions of Africans in America have been shaped to support Western institutions and their arrangements. One example is the idea of intellectual inferiority, an idea promulgated by early scholars and historians (How, 1971; Mellon, 1969). In its early

manifestations intellectual inferiority was seen as being *genetically inherited*. As Henry Osborne, a noted naturalist, wrote in 1913 "The Negroid stock is even more ancient than the Caucasian and Mongolian,... the standard of intelligence of the average adult Negro is similar to that of the eleven year-old youth of the species Homo Sapiens" (Osborne, 1980). With few exceptions (Herrnstein & Murray, 1994; Jensen & Johnson, 1994), the notion of *genetic* intellectual inferiority has been dismissed. However, the legacy of intellectual inferiority continues in the perception of African Americans being less capable or less successful intellectually or academically. In its modern form intellectual inferiority is often attributed to psychological, cultural or economic orientations. It is the notion of intellectual inferiority that led Mr. Ostrowski in the 1930's to conclude that a lawyer is "no realistic goal for a nigger." This same notion of intellectual inferiority led a teacher, described by Ladson-Billings (1994), to observe that "...there are 'white-blacks' and 'black-blacks.' The white-blacks are easy to deal with because they come from 'good' homes and have 'white' values. But the black-blacks are less capable academically and have behavior problems" (p.20).

A second reason for stressing the sociohistorical significance of race is that the process of making a scientist is a social one; and students learn to become scientists by participating in communities of practice (Lave & Wegner, 1991): K-12 science classes, undergraduate education, graduate school, postdoctoral research settings, and numerous internships. Access to and success in these communities is more directly a function of the social interactions one has with colleagues than the psychology, culture or economics of the participants. Additionally, science educators increasingly advocate instructional methods that include social interaction as a necessary component. The National Science Education Standards (National Research Council, 1996) for example, suggest that teachers establish science classes as communities of science learners in

which students collaborate with one another, take responsibility for the learning of one another, and engage in scientific discourse.

Hence, race is significant to career attainment inasmuch as the success of African American students in communities of practice is a function of (a) how they are perceived by teachers and peers, and (b) how the perceptions of teachers and peers shape the interactions they have with African American students. As math and science educators work towards equity and excellence in mathematics and science instruction (National Research Council, 1996), one area that must be considered is the perceptions that preservice teachers have of minority students, specifically African American students. To this end, the purpose of this study is to identify and describe the perceptions held by pre-service teachers about African American students' ability to achieve in mathematics and science.

METHODS

Research Participants

The preservice teachers that participated in this study attended a large Midwestern research institution and were students in teacher certification programs in science and mathematics education. Thirty preservice teachers participated in the study 19 females, 7 males and 4 that did not identify their gender. Of the 30 teachers, 24 were Caucasian, 1 was African American, and 1 was Asian American. Again 4 did not identify their race. The teachers' ranged in age from 21 to 44 years (see Table 1).

RACE	AGE	YEARS TEACHING	GENDER	TYPE SCHOOL
African American (1)	21 (1)	(1)	Female (1)	N/A (1)
Caucasian (24)	20-24 (16) 25-30 (7) 31-40 (0) 41+ (1)	Pre (23) 1-5 (1)	Female (17) Male (7)	Pub/sub (14) Pub (3) Both (1) Priv (2) Both sub/priv (2) Other (2)
Asians (1)	39 (1)	N/A	Female (1)	Pub/sub (1)
N/A	4	4	4	6

Table 1 - Demographic Representation of the Teachers Participating in the Study

Data Sources

Data for this study were collected through the use of a three part, open-ended questionnaire. The questionnaire begins with the following statement:

> There have been a number of reports in recent years which describe the science and math achievement of African American students. In general, these reports show that when compared to national averages, African American students have lower science and math achievement than their peers. This lower achievement is characterized by taking fewer science and math courses, performing more poorly on standardized exams, and pursuing science-related careers in lower numbers.
>
> Drawing on your experience as a science/math teacher, please answer the following questions in detail.

This statement is followed by three questions. The *first question* asks "Does your experience reflect what is found in these reports? (Please give one or more examples to elaborate upon and support your answer)." The *second question* instructs respondents to "Give at least 3 reasons for African Americans' science and math achievement. (Again, please give examples to elaborate upon and support each reason)." The *final question* instructs respondents to "Name at least 3 changes or interventions that you would suggest to address the science and math

achievement of African American students." These questions were aimed at getting respondents to be introspective; and identify their own informed opinions about the math and science ability of African American students. Given the potentially charged nature of the topic (the math and science ability of African Americans) the questionnaire sought to elicit teachers' opinions indirectly rather than directly. The participating preservice teachers were invited by instructors in introductory methods courses to fill out the questionnaires. Teachers were instructed that their participation in this study was voluntary, that their participation or lack thereof would not impact their course grade, and that responses would be confidential.

Data Analysis

Pilot data were used to develop coding criteria for the questionnaire responses. Responses to each question were analyzed individually and were read for answers to three questions. Responses to question number one were read to determine whether teachers either acknowledged or were aware of the math and science achievement of African American as reflected in reports. Responses were coded as either "Aware" or "Unaware."

Responses to question two were read to determine where teachers placed culpability for the math and science achievement of African American students. Responses were coded into one or more of fourteen categories. The first four categories (attitude, effort, interest, and motivation) identify student dispositions. The next six categories (curriculum, exams, instruction, school, teachers, and textbooks) identify aspects of the teaching and learning process. The final five categories (culture, family, peers, role models and socioeconomic) identify components of the students' culture and community.

Responses to question three were read to determine what (or who) teachers thought should be modified to improve the math and science achievement of African American students.

Responses were coded into one or more of seven categories. The first four categories (assessment, curriculum, instruction, and school) identify the teaching and learning process. The next category identifies the students' culture, community, or the students themselves. The final category identifies the scientific community.

Both questions two and three instructed teachers to give multiple part responses. While some teachers clearly indicated multiple parts others did not. Responses were coded according to complete and distinct thoughts, such that each complete and distinct thought was coded independently. Each complete and distinct thought was assigned one code.

FINDINGS

Expressing Awareness

The first questionnaire item asked teachers to indicate whether their experience reflected reports, that African Americans have lower math and science achievement than their peers. Teachers' responses were read and coded according to whether they indicated that teachers acknowledged and/or were aware of low math and science achievement among African American students. A response indicating that a teacher did not personally experience low African American achievement, but was aware of the likelihood or possibility of low African American science achievement was coded as "Aware." For example, one such respondent answered

> No, as an African American high school student my achievement was often higher than my peers. This was evidenced as I graduated in the top 10% of my high school class. This trend has continued in my experiences in college. I am aware of these studies and the results, however; personally my own experience (and that of my African American peers) does not reflect what is found in these reports [Aware].

The statement that "I am aware of these studies and the results" is clear acknowledgement that the teacher is aware of low African American science achievement despite not having experienced it directly. By contrast a response wherein a teacher expresses lack of awareness or is

not willing to acknowledge low African American science achievement was coded as "Unaware." For example, one respondent answered,

> No, my experience does not reflect this information. From my experience I have had with my internship I have gathered that African American students can have a higher achievement level than the rest of the class. I don't believe there is a cultural significance in the lower level students [Unaware].

Herein the teacher seems to take issue with the idea that the performance of lower achieving students is related to culture. Overall, greater than one-third of those responding to question one were either unaware of the low math and science achievement of African American students or did not wish to acknowledge this low achievement (see Figure 1).

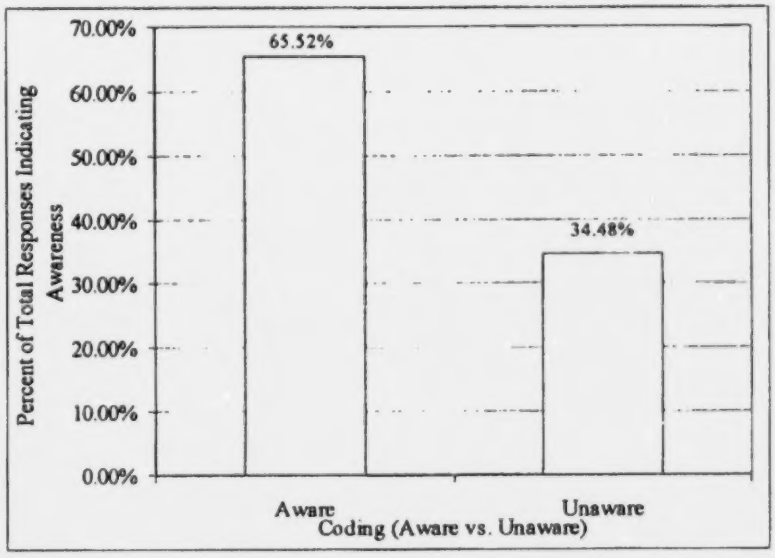

Figure 1 - Teachers' Responses to Question #1 Indicating Awareness of the Math and Science Achievement of African American Students.

Situating Culpability

The second questionnaire item asked teachers to suggest three reasons for the math and science achievement of African American students. Teachers' responses varied greatly and covered fourteen areas: attitude, effort, interest, motivation, curriculum, exams, instruction,

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school, teachers, culture, family, peers, role models, and socioeconomic status. Figure 2 contains a graph illustrating the percentage of teachers' responses in each of these areas.

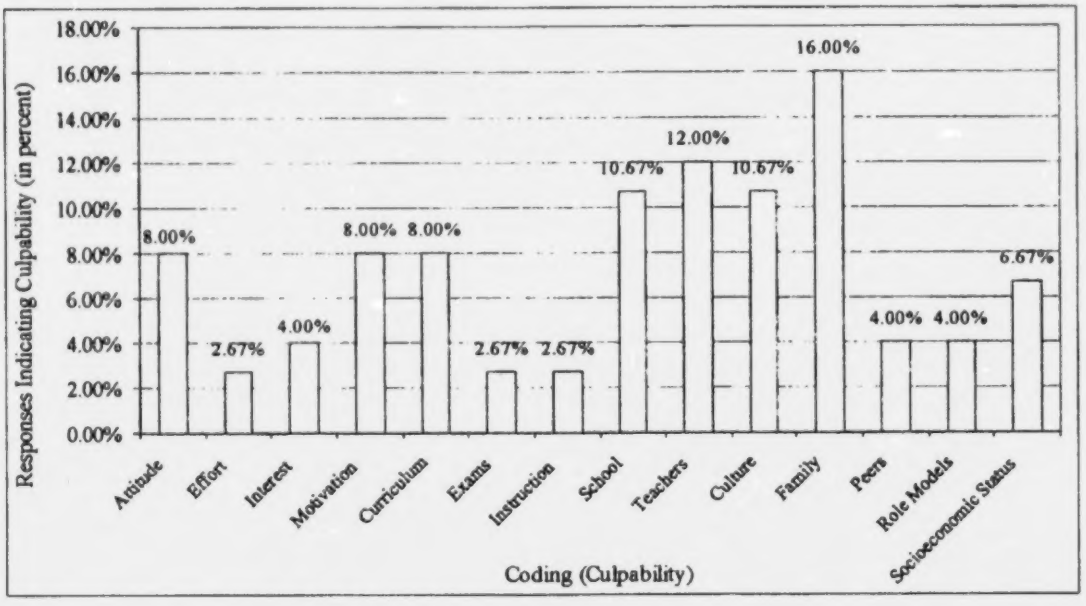

Figure 2 - Teachers' Responses to Question #2 Indicating Culpability in the Math and Science Achievement of African American Students.

It is clear from Figure 2 that teachers most frequently placed culpability for student achievement with "family" (receiving 16.00% of the responses) followed closely by "teachers" (receiving 12.00% of the responses). Both "school" and "culture" received the third most frequently cited sources of culpability (receiving 10.67% of the responses). At first glance it may seem that teachers' spread culpability fairly evenly. However, when these fourteen categories are grouped together to identify student dispositions, teaching and learning, and culture and community, it becomes apparent that teachers most frequently cite students' culture and community as sources of culpability (citing this category in 41.33% of their responses – see Figure 3). Moreover, when considering the three larger categories, teachers overwhelmingly place

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culpability of students' science achievement with students – citing student dispositions, and culture and community in over 60% of their responses.

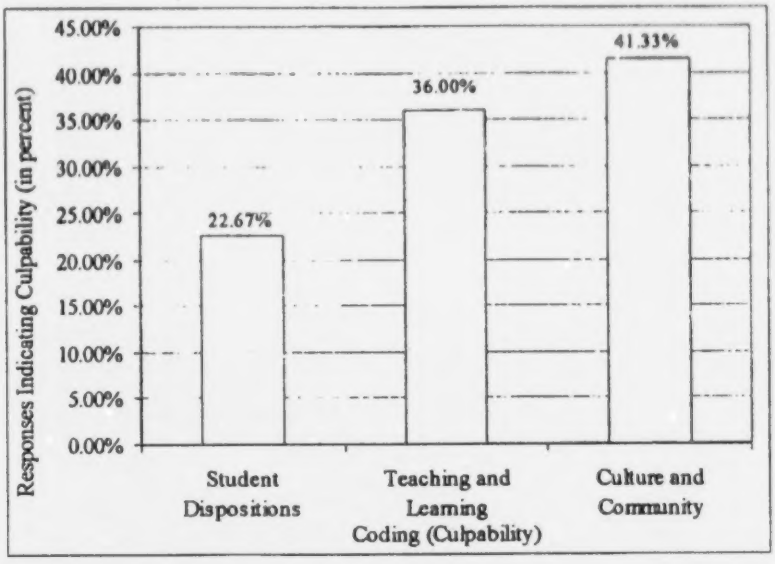

Figure 3 - Teachers' Responses to Question #2 Indicating Culpability in the Math and Science Achievement of African American Students.

Teachers' responses to question two also indicated that they were very thoughtful about the reasons that students might perform poorly. Their responses indicated a willingness to consider several possible explanations as well as thoughtful explanations of how multiple factors might interact with one another. One teacher's answer to question two contains complete and distinct thoughts that were coded into three categories. Citing family and SES as being culpable, this teacher stated that,

> In some cases there may be a lack of resources [SES] or family involvement [Family]. For example if a student has a lower socioeconomic status, he or she may not have the resources at home to keep up with assignments (Paul).

Later in the response this teacher also accounted for the role that teachers and/or prejudice

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can play in students' achievement.

> Maybe teachers have underlying prejudice and do not teach Black students on an appropriate level causing grades to drop [teachers]. (Paul)

This response indicates that teachers think broadly in their consideration of the factors that can affect the math and science achievement of African American students. Moreover it is clear that they do consider how these factors *interact* with one another. Another example is from a teacher who cites culture, effort and teachers as being culpable, this teacher stated that,

> Perhaps cultural differences are responsible (at least in part) for any achievement gap [culture]. My experience is that African American students are more "relaxed" in their academic pursuits (generally speaking) and often show up to class late or hand-in homework late [effort]. In our rushing dog-eat-dog culture this is seen as laziness and an "I don't care" attitude. This may not be the actual case at all. However, nevertheless they may get marked down for such behavior [teachers]. (Allison)

Suggesting Modifications

The third questionnaire item asked teachers to suggest three changes or interventions that might improve the math and science achievement of African American students. These results (see Figure 4) show that teachers overwhelmingly suggest modifications to the teaching and learning process in order to address the achievement of African American students (70.97%). To a lesser degree they suggest changes to the African American culture, community and student (25.01%), and changes to the scientific community are miniscule.

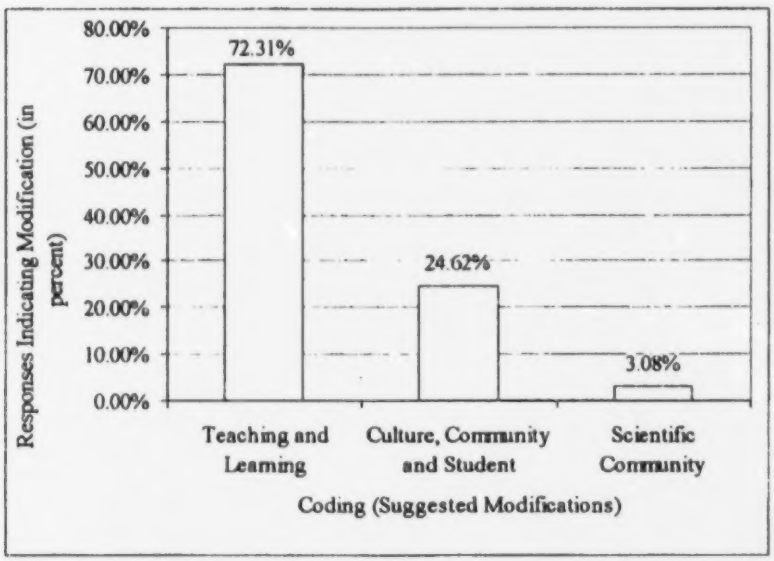

Figure 4 - Teachers' Responses to Question #3 Suggesting Modifications to Improve the Math and Science Achievement of African American Students.

One example of a response that suggests modification to the teaching and learning process recommends,

1) Encouraging teachers to pay equal attention to all students and not prejudge a student's performance by his/her cultural background.
2) Modify lessons to be cultural diverse and relevant to all students.
3) Recognize students of high achievement from different minority groups. (Ingrid)

A second example illustrates teachers' responses that suggested modifications to culture, community and students.

> I would suggest that African American leaders attempt to use their influence on the African American community to encourage them to value academics over athletics and music (shift in that direction anyway!).
>
> People need to be convinced that having a strong academic record is one of the most reliable guarantees of financial security (other than social skills). (AnnaBelle).

DISCUSSION

The teachers' perceptions of the math and science ability of African American students, as

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expressed in this study, are best characterized by King's (1991) notion of "dysconscious" racism. King describes dysconscious racism as "an uncritical habit of mind (including perceptions, attitudes, assumptions, and beliefs) that justifies inequity and exploitation by accepting the existing order of things as given" (p. 35). The idea of dysconsciousness speaks pointedly to the three types of information teachers provided. Teachers answers were assessed for *awareness* of, *culpability* in, and *modification* to improve the math and science achievement of African American students. So, in reference to awareness, dysconscious racism is characterized by persons being limited in terms of their knowledge and understanding of societal inequality (unaware). Moreover, it "is a form of racism that tacitly accepts dominant White norms and privileges" (unacknowledged).

Given the ubiquity and resilience of social problems that face the African American community it is surprising that more than one in three teachers were unaware or unwilling to acknowledge the low math and science achievement of African American students. The failure of so many teachers to make this acknowledgement is disheartening and it actually puts them in a position of dis-empowerment. If there is no condition to address then there are no efforts to address it. The result is that the poor performance of African American students is perpetuated.

In addition, while it is not surprising it is unfortunate that so many of the teachers' responses (more than two of every three) place culpability of math and science achievement with students. In terms of perception, the tendency to point to African American students disposition or community and culture suggests that teachers would expect African American students to enter class with deficits that work against achievement in math and science. Coupled with the tendency to ignore existing disparities in math and science achievement, this perception further exacerbates the teacher's dis-empowerment. Taken together the message is that, "There should be no inequity in the math and science achievement of African American students and their peers. Further if there

is any inequity the students, and their communities are responsible." Viewed in this way these perceptions reveal a subtle, abdication of responsibility. Finally, it is encouraging that teachers see the teaching and learning process as a vehicle for improving the math and science achievement of African Americans.

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